the species whence these timbers are derived. Thanks to the labours of Sir W. Schlich and Mr. W. R. Fisher, whose "Manual of Forestry" was published between 1889 and 1896, he is in a position to apply the principles of forest management with success under Indian conditions. But a gap was left in his equipment. He was without a systematic guide to the life-histories of those forest essences the products of which it is his business to dispose of to the best advantage. The importance of the factors that govern reproduction and condition the growth and survival of seedlings is now as fully realised in scientific forestry as it is in scientific agriculture.

Turning to account his own long and varied Indian experience, Prof. R. S. Troup has endeavoured to fill this gap by placing at the disposal of his former colleagues a comprehensive treatise on "The Silviculture of Indian Trees," now published under the authority of the Secretary of State for India by the Clarendon Press. Modestly regarding his work as an incentive to further study rather than an exhaustive presentation of his subject, Prof. Troup has fortunately taken a broad view with regard to the species dealt with. That a difficulty should have been felt may easily be appreciated. The area administered by the Indian Forest Department is of wide extent and is diversely conditioned as regards both soil and climate. It includes dry plains, where the rainfall may be negligible, and wooded escarpments with an annual precipitation that may exceed 400 in. It contains tropical uplands well under the normal cloud canopy of the rainy season, and temperate mountain valleys swathed in mist for weeks at a time. It extends from the mangrove forests at the outfalls of Indian rivers to the upper limits of Himalayan trees. The number of arboreal species met with is necessarily great. Not all of these, however, yield useful products; many of those that do are limited in distribution or occur but sparingly, so that their timbers, though often employed locally, are little known, if known at all, in commercial circles. The decision to deal in this work with most of the species the wood of which is known to be of value will meet with the approval of all who may use it, as will the further decision to deal with the life-histories of exotics like those Australian "gums" and American "mahoganies" the cultivation of which has become definitely established in India. But in dealing with the trees thus included the author has shown a due sense of proportion, for while the accounts of elements so important as sal and teak, chir and deodar constitute veritable monographs, trees of minor consequence are discussed with commendable brevity.

The illustrations with which the work has been provided deserve especial notice. The series of coloured plates in which seeds, germinating seedlings, and young plants are displayed are of great interest and value; the remaining drawings and the photographs are well chosen, carefully reproduced, and always instructive.

Prof. Troup will doubtless prove justified in his hope that this work may induce further research in what is a fascinating and important field. Meanwhile it is possible to say that, as a complement to those of his distinguished precursors, his work is worthy of the ægis under which it has been produced, and will prove as indispensable to the Indian forest officer as that of Gamble on "Indian Timbers" and that of Brandis on "Indian Trees."

The Works of Cavendish.

The Scientific Papers of the Honourable Henry Cavendish, F.R.S. Vol. 1: *The Electrical Researches.* Edited from the published papers and the Cavendish manuscripts in the possession of his Grace the Duke of Devonshire, K.G., F.R.S., by Prof. J. Clerk Maxwell. Revised by Sir Joseph Larmor. Pp. xxviii + 452. Vol. 2: *Chemical and Dynamical.* Edited from the published papers and the Cavendish manuscripts in the possession of his Grace the Duke of Devonshire, K.G., F.R.S., by Sir Edward Thorpe, with contributions by Dr. Charles Chree and others. Pp. xii + 496 + 6 plates. (Cambridge: At the University Press, 1921.) 6*l.* net 2 vols.

THE Cambridge edition of the scientific papers of Henry Cavendish is much more than a mere reprint. In 1879 an edition of the electrical researches was published, a work to which Clerk Maxwell, the first Cavendish professor of experimental physics, devoted the last five years of his life. This long period was required because Cavendish had left behind, in addition to his papers in the Philosophical Transactions, a manuscript record of many experiments which were not published, but were sufficiently precise to prove that he was familiar with the theory of divided currents; had made a most extensive series of experiments on the conductivity of saline solutions in tubes, compared with wires of different metals; and had found out the inductive capacity of glass, resin, and wax. These manuscripts occupy 255 pages of the present edition as compared with sixty-six pages which are covered by the two published papers on electricity. In addition, Clerk Maxwell's introduction and notes extend over more than 100 pages, and form a permanent record of his work on the manuscripts. The new edition of the electrical researches, which now forms vol. 1 of the "Scientific Papers," has been prepared by Sir Joseph Larmor, who has added a preface and a number of notes such as were needed to bring Clerk Maxwell's commentary up to date, and has made a number of improvements in the text as issued just before the death of the first editor.

The chemical and dynamical researches which form the second volume of the "Scientific Papers" are edited by Sir Edward Thorpe, and have not been issued previously. In this case the proportion of published papers is much larger, but the seventy-four pages of introduction form a masterly review of Cavendish's work as a chemist, and bring out in a remarkably clear way some of the main features of this work. Thus it appears, not only from the papers, but also from the manuscripts, to how large a degree Cavendish's experiments assumed an accurately quantitative character—even the alkalis that he used were standardised by neutralising with nitric acid and weighing the nitre which they yielded on evaporation. It was perhaps this passion for exact measurements that caused him to withhold from publication much of his experimental work, as, for instance, part 4 of his "Experiments on Factitious Air," in which he studied with much care, but without securing completely consistent measurements, the mixtures of gases (carbon monoxide and dioxide, marsh-gas, and hydrogen) produced by the destructive distillation of wood, tartar, and hartshorn.

A second feature to which the editor directs much attention is Cavendish's adhesion to the doctrine and language of the phlogiston theory. The doubt as to Cavendish's claim to the discovery of the composition of water, which is indisputable as a matter of experiment, rests mainly on the ambiguous expression of his results in the language of this theory. Those who have read his published papers are familiar with the necessity that exists for thinking of oxidation when Cavendish speaks of dephlogistication; but it is perhaps fortunate that the letter written by Cavendish to Blagden on the receipt of a copy of Lavoisier's "Nomenclature Chymique" was not published at the time, for it contains a strong protest against naming substances in terms of a theory, a protest which is scarcely justified from one whose writings, almost from beginning to end, require to be translated mentally, in order to disentangle them from the language of an obsolete theory in terms of which they are expressed.

The unpublished manuscripts on chemistry contain a considerable amount of valuable material. An unpublished paper describing Cavendish's "Experiments on Arsenic" (probably made in 1767) shows that he was familiar with the oxidation by nitric acid of white arsenic to arsenic acid, and that he had fully investigated the properties of the latter acid and its salts, probably ten years before Scheele. He considers, however, that "the only difference between plain arsenic and the arsenical acid is that the latter is more thoroughly deprived of its phlogiston than the former," and does not recognise the significance of the gain in weight which he had found to accompany the oxidation. His unpublished "Experiments on Tartar" also compete in interest with the paper in which Scheele, in 1769, first described the properties of the acid; but it is not clear whether Cavendish's two series of experiments preceded and followed the publication of this paper, or were all carried out independently of it. A note on the "Solution of Metals in Acids," which was withheld from the first paper on "Factitious Air," explains the action of nitric acid in dissolving metals as due to the "affinity of the phlogiston of the metals to the nitrous acid," giving rise to vapours "composed of the nitrous acid united to the phlogiston of the metal." The influence of phlogiston also appears in Cavendish's incredulity when he found that charcoal deflagrated with nitre showed a loss in weight which was smaller than the loss of weight when the carbonate of the ash was decomposed by acids—from his point of view the "fixed air" in the ash was wholly derived from the charcoal by a mere process of dephlogistication, and the oxygen contributed by the nitre was not allowed for; in the same way, it may be noted, Lavoisier at first tried to recover oxygen from mercuric oxide by heating it with charcoal—a phlogisticating agent the material character of which was realised only when at last the theory of phlogiston was obliged to release its strangle-hold on the growing science of chemistry.

One other service which the editor of the chemical and dynamical researches has rendered to the vindication of the merits of Cavendish as a pioneer worker in science is seen in his detailed study of the experiments on the freezing of aqueous acids, which Cavendish carried out with the co-operation of Mr. John McNab, of Albany Fort, Hudson Bay, as described in the Philosophical Transactions of 1788. Sir Edward Thorpe is able to show, by a comparison with modern measurements, that Cavendish and his colleague froze out and separated the hydrates $HNO_3,3H_2O$, $HNO_3,2H_2O$, and H_2SO_4,H_2O; determined accurately their compositions and melting points, as well as those of the eutectic mixtures in which these hydrates are concerned; and secured data which can be plotted with remarkable accuracy on a modern freezing-point diagram.

In addition to the chemical papers and manuscripts, the second volume of the "Scientific Papers" includes reprints of the remaining papers, of which the most important describes the well-known "Experiments to Determine the Density of the Earth." In dealing with this section of Cavendish's work the editor has obtained contributions from Dr. Chree, who writes a note on the determination of the height of the aurora, and gives an account of Cavendish's magnetic work; from the Astronomer Royal, who writes on Cavendish's astronomical manuscripts; from Sir Archibald Geikie, who writes on Cavendish as a geologist; and from Sir Joseph Larmor, who adds a note to a manuscript on "The Refraction on a Mountain Slope," and gives an account of Cavendish's mathematical and dynamical manuscripts.

It is a tribute to the work which has been expended on these two volumes that only sixty-six out of 452 pages of the first volume, and 220 out of 496 pages of the second, are occupied by reprints of the papers from the Philosophical Transactions. The Cambridge University Press has produced a worthy memorial of the work of one of the most distinguished of Cambridge men, and no student of the history of science in England can afford to ignore or to neglect these volumes.

T. M. L.

Paris Weather Statistics.

Atlas Météorologique de Paris. By Joseph Lévine. Pp. vi + 83 + 9 plates. (Paris: Gauthier-Villars et Cie, 1921.) 20 francs.

MUCH more will be found in this atlas than is to be inferred from the title. The author promises to set out graphically the annual values of meteorological elements for Paris from 1700 to 1920, with monthly values from 1761. This is shown in a series of plates. He also gives complete monthly and annual tables for several elements from 1874 to 1920, with a column of annual departures from average, and of variations from year to year. The wind tables are not so full, as they date back only to 1890, and some of the other tables do not begin until 1876 or 1878. In addition, there is a table of extreme barometer readings from 1809 to 1919 for each month and for the year, and of highest and lowest mean monthly and annual readings from 1757 to 1919. The highest recorded barometer reading at an altitude of 67 m. was 781·2 mm. in February, 1821, and the lowest 713·5 mm. in December of the same year. During the period from 1878, of which fuller details are given, the highest readings were 782·4 mm. on January 16, 1905, and 782·3 mm. on January 17, 1882, at an altitude of 50·3 m. (corresponding to 780·7 mm. at an altitude of 67 m.), and the lowest 718·1 mm. on January 10, 1916. It is to be remarked that at Greenwich, in the same period, the highest readings—782 mm.—were recorded on January 17, 1882, and January 29, 1905. The latter was nearly a fortnight later than the Paris maximum, though the former was on the same day, indicating a very extensive anticyclone, with possibly an even higher reading at some intermediate point. Naturally, no such accordance can be expected in the minimum readings.

The highest shade temperature at Paris was 38·4° C. (101·1° F.) on July 20, 1881, five days after the Greenwich reading of 97·1° F., which has been exceeded only by that of 100·0° F. on August 9, 1911, on which day the Paris reading was 97·7°. The lowest shade minimum in the same period at Paris was −25·6° C. (−14·1° F.) on January 20, 1879, about 20° F. lower than anything at Greenwich since 1841; but in spite of the greater rigour of the Paris frosts, they occur neither so early nor so late as at Greenwich. The limiting dates at Paris are October 5 and May 13; at Greenwich, September 27 and May 24. The corresponding limits for ground frost at Paris are September 13 and June 9, but the period covered by the table is only from 1902 to 1920. There are no real limits at Greenwich for ground frost, for it has been recorded during the same period in both July and August.

The mean rainfall of Paris is about an inch less than that of Greenwich. In the forty-six years of the table 28 in. was exceeded at Paris twice, and at Greenwich eight times. On the other hand, in six years at Paris, and in only two at Greenwich, did the annual total fall below 19 in.

Unfortunately, there is scarcely any information about duration of sunshine. The author remarks that the record is not homogeneous, and gives only the figures for 1919.

W. W. B.